

10/563,199  
September 1, 2006

ERP02.001APC1

PATENT

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

Applicant	: Brownlie et al.
App. No	: 10/563,199
Filed	: September 1, 2006
For	: VACCINE COMPOSITION FOR VACCINATING DOGS AGAINST CANINE INFECTIOUS RESPIRATORY DISEASE (CIRD)
Examiner	: Archie, Nina
Art Unit	: 1645
Conf No.	: 6472

**DECLARATION UNDER 37 C.F.R §1.132**

**Mail Stop Amendment**

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

Dear Sir:

1. I, John ('Joe') Brownlie, BVSc, PhD, DSc, DipECVP, ARAgS, FRCPath, FRCVS, am an inventor of the present application.

2. I have extensive experience in the fields of virology and immunology for over thirty years. My current positions are Professor of Veterinary Pathology in the Department of Pathology & Infectious Diseases at The Royal Veterinary College, London (since 1995), and Director of the European Centre for Toxicologic Pathology at The Royal Veterinary College, London (since 1999). My Curriculum Vitae is attached herewith as Exhibit A.

3. I conducted a study to examine the acquisition of antibodies directed against *M. cynos* in the serum of dogs following challenge with an immunogenic composition comprising an agent capable of raising an immune response against *M. cynos*.

### **Study Design**

4. Nine, 4-7 week old specific pathogen free purpose bred beagle dogs were used in this study. Dogs were housed in temperature controlled isolation rooms. Dogs were divided into 3 treatment groups (T03, T04, T05/6) (Table 1). Dogs from treatment groups T03 and T04 were housed together (within the litter they were born) along with the dam to minimise stress. Dogs from treatment group T05/6 were housed together (within the litter they were born) along with the dam.

5. T03 dogs were inoculated with *M. cynos*. Group T04 consisted of three dogs which served as sentinels for the inoculated dogs in groups T03. Group T05/6 consisted of two dogs which were inoculated with uninfected culture medium to serve as negative controls.

6. Inoculations took place over three consecutive days. On study day zero dogs were inoculated intranasally with 0.2ml of *M. cynos* or control material in one nostril. On study days one and two dogs were inoculated by the intra-tracheal route with 0.2ml of *M. cynos* or control material. Sentinel dogs were housed with inoculated dogs from study day zero until the end of the trial. Dogs were monitored throughout the trial for clinical signs of disease. On study days - 3 (pre-inoculation), 9, 16, 23, and 30 dogs were randomly selected to be blood sampled as detailed in Table 1. The sera was harvested and stored at -20°C.

**Table 1: Study Design**

Study group	Dog number	Treatment	Day of sera samples
T03	262611	<i>M. cynos</i>	-3, 9
	250508		-3, 9, 16
	256367		-3, 9, 16, 23
	255451		-3, 9, 16, 23, 30
T04	295445	Sentinels to group T03	-3, 9, 16
	277489		-3, 9, 16, 23
	293160		-3, 9, 16, 23, 30
T05/6	216037	Broth controls	-3, 9
	217014		-3, 9, 16, 23, 30

### **Results of *M. cynos* ELISA**

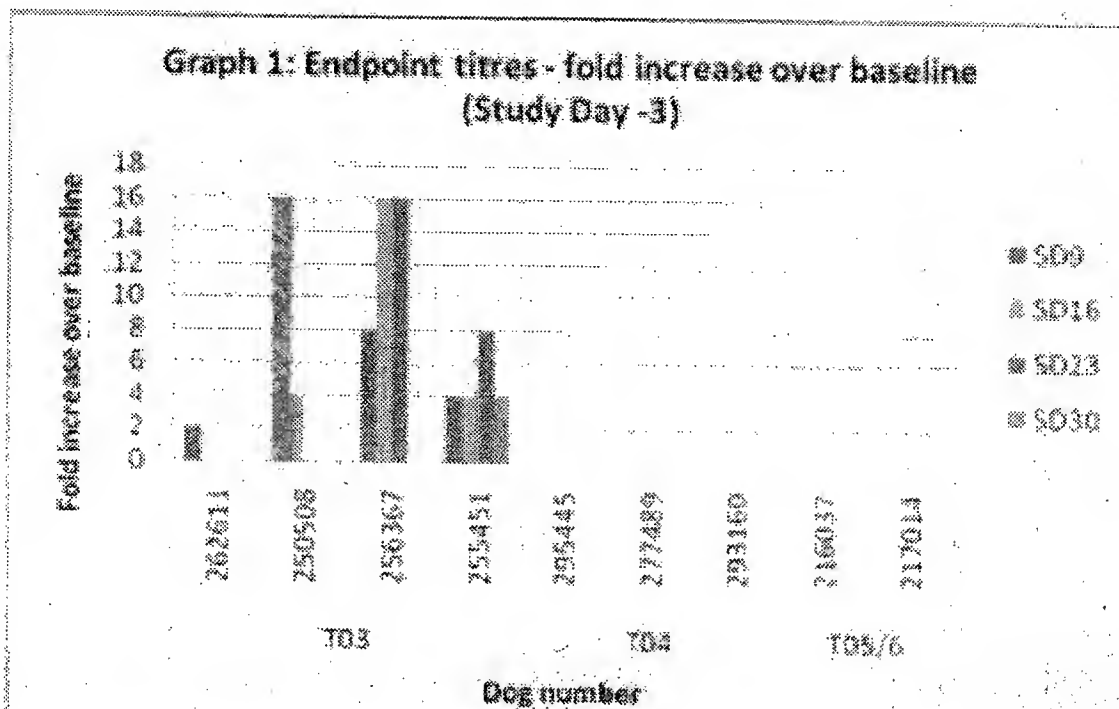
7. Serum collected from dogs in study groups T03 (*M. cynos* Challenge group), T04 (*M. cynos* sentinel group), and T05/6 (Broth Control group) was tested in an ELISA specific assay for the detection of antibodies to *M. cynos*. Serum was determined to be positive for *M. cynos* antibodies if the optical density (OD) was greater than the cut-off value when the serum was tested at a 1/100 dilution. The ELISA cut-off value was calculated by adding three standard deviations to the average OD value of negative control sera at 1/100 dilution. In addition, sera were tested in a dilution series ranging from 1/50 to 1/3200 to determine the end-point titer. The end-point titer was defined as the highest antibody dilution which was greater than the ELISA cut-off value. The endpoint titers of the sera are shown in Table 2.

**Table 2: Endpoint Titers of Sera**

Study group	Dog number	Study Day				
		-3	9	16	23	30
T03	262611	50	100	-	-	-
	250508	<50	800	200	-	-
	256367	50	400	800	800	-
	255451	200	800	800	1600	800
T04	295445	400	400	400	-	-
	277489	100	100	50	100	-
	293160	100	100	50	50	50
T05/6	216037	<50	50	-	-	-
	217014	<50	50	50	50	50

8. Graph 1 shows the fold increase of the endpoint titers at study days 9, 16, 23, and 30 over the baseline endpoint titer at study day -3.

9. Seroconversion was defined as the acquisition of antibodies directed against *M. cynos*. For treatment group T03, all four dogs challenged with *M. cynos* seroconverted by Study Day 9, confirming exposure of these animals to *M. cynos*. The increase in antibody titer at study day 9 ranged from a two-fold increase (in dog 262611) to over a 16-fold increase (in dog 250508). The sentinel dogs (T04) and those challenged with broth controls (T05/6 and T06) did not seroconvert.



10. In conclusion, an immunogenic composition comprising an agent capable of raising an immune response against *M. cynos* elicited an immune response in dogs as indicated by the acquisition of antibodies directed against *M. cynos*.

11. I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful, false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or patent issuing therefrom.

Dated:

July 2009

By:

Dr. John Brownlie

## **EXHIBIT A**

# CURRICULUM VITAE

## **PROFESSOR JOE BROWNLIE**

Professor of Veterinary Pathology

*BVSc PhD DSc DipECVP FRCPath ARAgS FRCVS*

THE ROYAL VETERINARY COLLEGE

Department of Pathology & Infectious Diseases

Hawkshead Lane, North Mymms, Hatfield, Herts AL9 7TA



***Personal Details:***

Birth: 7<sup>th</sup> January 1944, Oxford      Nationality: British  
Status: Married

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Hatfield, Herts, AL9 7SA  
  
Tel: 01707 652646

***Current Posts:***

Professor of Veterinary Pathology in the Department of Pathology & Infectious Diseases at the Royal Veterinary College, London - 1995 to present  
  
Director of European Centre for Toxicologic Pathology at the Royal Veterinary College, London – 1999 to present

***Qualifications:***

BVSc      *Bristol (1967)*  
MRCVS      *Royal College of Veterinary Surgeons London (1967)*  
PhD      *Reading (1972)*  
DipECVP      *European College of Veterinary Pathology (1996)*  
FRCPath      *Fellow of the Royal College of Pathologists (2001)*  
DSc      *Bristol (2004)*  
FRCVS      *Fellow of the Royal College of Veterinary Surgeons (2005)*  
ARAgS      *Associate of Royal Agricultural Societies (2008)*



## Professor Joe Brownlie

### *Contributions to the advancement of knowledge in veterinary science & medicine:*

Prof Brownlie has made major contributions to our understanding of a number of infectious diseases, most notably bovine virus diarrhoea virus (BVDV), bovine immunodeficiency virus (BIV), foot-and-mouth virus, bluetongue and more recently canine infectious respiratory disease (CIRD). He was the first person to unravel the complex pathogenesis of mucosal disease, to show the biological relevance of the two biotypes of BVDV and to demonstrate the molecular difference between them. He also, with his colleagues, developed the first BVDV vaccine with proven protection for the foetus and took that academic discovery through to commercial development to become the 'gold standard' BVD vaccine (as described in the Veterinary Record) – the vaccine was Bovidec. He has since made real progress with understanding the molecular nature of the virus and the immune protective responses against BVDV (all published work). He has now uncovered further novel mechanisms for long term viral persistence after acute infection and was the first to show vertical transmission through the oocyte. This had implications for international trade in embryos. Much of his present work is concerned with the discovery and development of a 'marker' BVD vaccine that would become a worldwide vaccine. Already he has published important papers on DNA and sub-unit vaccine constructs which have potential for future vaccines. He is also directing a research programme to identify the basis for virulence in the virus with some, particularly the Group 2 viruses, able to cause fatal disease whereas others are almost sub-clinical in their pathogenicity. He and his team have already constructed an infectious copy of the virus and are presently examining the biological role of different viral genes.

It is extremely rare for an academic to carry a research programme on infectious disease from fundamental discovery through development to a commercial vaccine. Professor Brownlie, by his career's end, is highly likely to have done this four times! The first, as described above, is the BVDV inactivated vaccine, Bovidec; the second will be the 'marker' BVDV vaccine which is presently in development. For both these vaccine, there are patents in which he is an inventor. The next two vaccines relate to his canine infectious respiratory programme (CIRD).

In 1999, Professor Brownlie was approached by two major dog re-homing and training kennels to investigate the growing problem of severe, and sometimes fatal, respiratory disease. The current vaccines were not protective and the situation was getting worse. He assembled an excellent team to look for new microbiological agents. Since that time, they have discovered a new canine respiratory corona virus (CRCoV) and new associations for bacterial and mycoplasma agents in this complex disease. In order to support this research programme, he has obtained more than £1.5M over the last few years and has worldwide patents on CRCoV, and the inclusion *M.cynos* & *St zooepidemicus* into novel vaccines. Already preliminary vaccines trials for CRCoV have been conducted by Professor Brownlie and his commercial partner with most encouraging results. He has been to the Regulatory Authorities in USDA recently with an invitation to launch a CRCoV vaccine in 2009. The fourth vaccine will be a Mycoplasma vaccine, for which there is both a patent and commercial funding, to deliver by 2010. The evidence is that these vaccines will be both worldwide and have a real impact of the incidence of respiratory disease whether for rehoming or for vacation kennelled dogs.

The last aspect of Professor Brownlie's research is that associated with the exotic diseases. He is presently supervisor to 6 students at IAH, Pirbright Laboratories working on FMDV, Bluetongue & the Morbilliviruses (PPR and Rinderpest). He is the Principal Investigator for a programme of FMDV transmission across the placenta of pregnant sheep. In that work, he has been able to demonstrate transmission of FMDV across the placenta with subsequent abortion, death of the foetus and, importantly, the persistence of virus in the foetus for periods longer than in the recovered dam. This is the first published work of its kind and demonstrates a hitherto unrecognised risk pathway for

maintenance of virus in the field. He is also co-supervisor for bluetongue work on 'overwintering' of BTV and the genotypic variation for midge vectors.

### ***Other scientific contributions which enhance the reputation of veterinary science:-***

In terms of comparative medicine, Professor Brownlie initiated in the 1980's the **Comparative & Veterinary Immunology Group** as a national organisation to discuss and share research and technologies on immunology. This was a developing science at the time and, for a number of years, he was both Chairman and secretary; 3-4 meetings were held annually at the Institute of Zoology in London. This Group became incorporated into the British Society of Immunology and, furthermore, became the 'blueprint' for similar organisations in Canada and USA (and now worldwide). There are now International Conferences for Veterinary (and Comparative) Immunologists every 3-4 years.

More recently, he was asked to become the veterinary expert member of the Co-ordination team (4 members) of Professor Sir David King's **Foresight programme on 'Detection and Identification of Infectious Diseases'** programme. As such, he represented veterinary science and veterinary issues, particularly for the future risks and technologies over the next 25-30 years. This was a considerable undertaking and, for which, the veterinary profession was well considered. The major outcome of the need for a 'One Medicine' approach to disease has had considerable impact at the highest level (G8, World Bank, Wellcome Trust, Google and Rockefeller).

(a) Brownlie, J, Peckham, C, Waage, J, Woolhouse, M, Lyall, C, Meagher, L, Tait, J, Baylis, M & Nicoll, A. (2006). Foresight. Infectious Diseases: preparing for the future Future Threats. Office of Science and Innovation, London p1-83. (b) King, D A, Peckham C, Waage, J K, Brownlie, J, & Woolhouse, M. (2006) Infectious Diseases – Preparing for the future. *Science* Sept 8<sup>th</sup> Vol 303:1392-1393.)

Furthermore, this Foresight programme has looked at the issues of new and emerging diseases in UK, sub-Saharan Africa and China. The follow-up has been opportunities to work within a comparative 'One Medicine' framework. Professor Brownlie has worked strongly to position veterinary science in both this framework and in Africa.

He has been appointed by the Chief Medical Officer to his committee on **National Expert Panel for New & Emerging Infections (NEPNEI)**. He has been appointed as the veterinary expert with knowledge of infectious diseases. This develops advice for the CMO and informs him on necessary action and research required.

He has been appointed as Specialist Adviser to the **House of Commons Select committee on 'Biosecurity in UK Research Laboratories'**. This is a wide ranging review of facilities, capabilities and training in both medical and veterinary establishments; and those private, Government and academic laboratories working with infectious agents.

He has recently been made Chairman of Trustee's of the Institute of Animal Health (IAH) and, in that position, will oversee, in the coming years, the redevelopment of the IAH as a national resource for veterinary science and surveillance.

### ***Service to the Veterinary Profession:-***

Professor Brownlie has held High Office in both of the veterinary research organisations; having been both President of the BVA's **Association for Veterinary Teachers and Research Workers (AVTRW)** and President of the **Veterinary Research Club**.

He has been Veterinary Consultant to a number of organisations, most notably the **British Cattle Veterinary Association** (BCVA) during the 2001 FMDV Outbreak. During that period he was co-opted to Professor Sir David King's Group that met (daily, weekly and then at longer intervals) as a veterinary academic with detailed knowledge of the disease in veterinary species. This was a vitally important time for veterinary advice and, between himself and Dick Sibley; they helped moderate the thinking and policies of control and culling of livestock. Furthermore, the two of them are credited with saving the BSAVA Conference that year with their Conference Opening speeches – but that was another story!

He has served as director on the Board of **Moredun Scientific Ltd (MSL)** for a number of years and recently stepped down to take up the appointment as a member of the **Scientific Strategy Advisory Panel** for SEERAD that undertook a review of the future direction, management and funding of Scottish Agricultural sciences in its widest context.

He has also acted as scientific consultant to a number of Presidents of both RCVS and BVA over the years. More recently being consultant to the CVO and other Defra colleagues.

Professor Brownlie acts on the international stage having been consulted by governments in Canada, USA, Australia, New Zealand, Europe, Indian sub-continent and the Middle East. He is consultant to a number of Pharmaceutical companies particularly on identifying future risk, opportunities and vaccines.

One further area where he has made an impact has been the initiation, development and funding of an elite course at the RVC on Veterinary Pathology. He has developed this intercalated (1 year) course, that is research-rich, in conjunction with the Wellcome Trust and has attracted nearly 100 veterinary undergraduates over the past seven years from all UK (except Cambridge) veterinary colleges, Dublin and Uppsala. This has become a 'Flag-ship' course for attracting veterinary graduates into research (at present, about 80% of graduates from this course undertake post-graduate training and research whereas the average for veterinary undergraduates is less than 10%).

Possibly the greatest contribution that Professor Brownlie has made to the profession, over and above his research, has been his commitment and drive to educate, co-ordinate and deliver a programme on BVD control. From his CV, it is clear that he is unstinting in his commitment to travel to national, veterinary practice and even farmers meetings to engage groups in BVDV control. He rarely expects to be paid for this work and rarely refuses to help veterinary colleagues. At a higher level, he has initiated the National Strategy Group for BVD Control and Chairs it. Through this Group, he has delivered national models for BVDV Control and is hoping to integrate a national programme. Already, many practices have undertaken local control programmes and he is hoping to step this up to a national level. It would be a fine achievement for an academic to deliver such a voluntary programme on the national stage!

Professor Brownlie has also published over 120 peer-reviewed publications. List of refereed publications can be found at <http://www.rvc.ac.uk/AboutUS/Staff/jbrownlie/Publications.cfm>

### ***Personal Awards and Honours***

2008

**Dalrymple-Champneys Cup & Medal** - awarded by the British Veterinary Association in recognition of long and outstanding services to veterinary science

2007

**Selborne Research Medal** – awarded by the Association of Veterinary Teachers and Research Workers of Great Britain and Ireland “in recognition of excellence and achievement in veterinary research”

2006

**James Bee Educator Prize** – awarded by the Royal Veterinary College on Graduation Day “for outstanding leadership and conduct of the BSc (Hons) in Veterinary Pathology Intercalated Course”

1997

**JTL (Larry) Smith Memorial Lectures** at the Western College of Veterinary Medicine, Saskatoon, Canada (March)

1994

**J.T. Edwards Memorial Medal** - Royal College of Veterinary Surgeons awarded at the RCVS day, London “outstanding work in the fields of Pathology, Bacteriology and Virology”

1992

**Pfizer Award 1992** - World Association of Buiatrics  
awarded at World Congress of Buiatrics, St Pauls, Minnesota, USA. “for outstanding contribution to the advancement of knowledge in the origin and treatment of bovine diseases caused by microorganisms”

**Research Medal 1992** - European Society of Veterinary Virology awarded at the ESVV meeting, Annecy, France. “in recognition of outstanding achievements in the field of pestivirus research”

1990

**Centenary Award 1990** - British Veterinary Association  
awarded at the BVA Congress, London (Co-awarded with MC Clarke & CJ Howard) for the outstanding paper of 1990 in Res. Vet. Sci. which “represents a turning point in our understanding of the pathogenesis of mucosal disease in cattle”

1989

**Research Medal 1989** - Royal Agricultural Society of England  
awarded at the Royal Show by HRH Duke of Gloucester. “In recognition of distinguished research on unravelling the pathogenesis of the bovine virus diarrhoea/mucosal disease complex.”

1984

**Peter Bridge Award** from the British Cattle Veterinary Association “for best scientific contribution to cattle medicine at BCVA” awarded at the BCVA meeting, Warwick.

1978

**Commonwealth Veterinary Interchange Fellowship** to Ontario Veterinary School, Guelph, Ontario, Collaborative studies with Professors Brian Derbyshire and Bruce Wilkie on recirculation of lymphocyte in cattle to respiratory tissues. Invited lecture to the Canadian Veterinary Medical Association, Moncton, New Brunswick, Canada.

1977

**Visiting Fellowship** from Basel Institute of Immunology to visit Basel and work with Professor Ross Cahill and Professor Z. Trnka on sheep lymphocyte recirculation studies in the neonatal gut.

1975-76

**Royal Society Award** for studying with Professor Bede Morris at the John Curtin Medical School, Australian National University, Canberra, Australia. Research programme was to investigate the specific T-cell depletion by chronic lymphatic duct cannulation from repeatedly challenged lymph nodes. The study demanded acquiring lymphatic duct cannulation skills and a knowledge of lymphocyte recirculation pathways.

### *Employment & Professional Activities History:*

- 2009      Appointed as Chair of Corporate Trustee Team for Institute of Animal Health.
- 2008      Specialist Adviser of the Innovation, Universities and Skills Sub-Committee's inquiry into Biosecurity in UK Research Laboratories
- 2007      Appointed as expert member with expertise as a veterinarian to the National Expert Panel on New and Emerging Infections (NEPNEI) for a period of 3 years – Jan 2007-Dec 2009
- 2006      Elected Expert Member of the Strategic Scientific Advisory Panel for Scottish Executive, Environmental and Rural Affairs (SSAP SEERAD) (2 years)
- Proposed, established and Chairs expert advisor group to examine a 'National Programme for BVDV Control –UK
- EFSA Invited Scientific Consultant – Risk Assessment for Entry of FMD into Europe
- Launch of the Foresight Initiative (Detection & Identification of Infectious Diseases) under Professor Sir David King (April)
- Keynote lecture in Wellcome Trust Frontiers meeting on 'Emerging and Zoonotic infections' – Sanger Centre, Cambridge.
- Application for Patent for 'BVDV Marker vaccine'
- 2005      Veterinary expert on Scientific Co-ordination Team of Foresight Initiative (Detection & Identification of Infectious Diseases) under Professor Sir David King
- 2004      Professor of Veterinary Pathology in the Department of Pathology & Infectious Diseases at the Royal Veterinary College, London – 2004-present
- Member of Scientific Review Team for Australian Centre for International Agricultural Research (ACIAR), Australia and Indonesia (April)
- Invited to expert meeting with Chief Veterinary Officer
- Veterinary expert on Scientific Co-ordination Team of Foresight Initiative (Detection & Identification of Infectious Diseases) under Professor Sir David King
- Member of the EFSA expert group on 'Assessing future risks of FMD introduction to Europe'
- Member of the EU Thematic Network on 'European Control of Bovine Virus Diarrhoea Virus' – Chairman of Subgroup on BVDV Vaccines
- 2003      Royal College of Veterinary Surgeons member on the Royal College of Pathologists specialist advisory committee for pathology
- Invited to accompany Professor Sir David King on House of Commons Select Committee to examine the Department of Environment, Food and Rural Affairs Committee (DEFRA) enquiry on Vets and Veterinary Services

- 2 patents for **Canine Respiratory Corona Virus (CRCV)** granted
- 2002      Discovered new virus responsible for severe respiratory disease in dogs – **canine respiratory corona virus (CRCV)**
- 2001      Scientific Member of Veterinary Laboratories Agency Science Audit
- Veterinary LVI on “front line” duty in Cumbria during FMD outbreak (March)
- Chief Government Scientist Scientific Advisory Group for FMDV** (2001) an independent member (invited by Professor Sir David King) to join the Science Advisory Group during the FMDV outbreak
- Appointed as **Director of Moredun Scientific Limited**, (Non-Executive), Edinburgh, Scotland
- Scientific Consultant to the British Cattle Veterinary Association**
- 2000      **Development and Course Director** of new **Intercalating BSc (Hons) in Veterinary Pathology** – open to veterinary undergraduates of all UK/Irish Veterinary Schools and funded by **Wellcome Trust**
- 1999      **Director of European Centre for Toxicologic Pathology** at the Royal Veterinary College, London
- External examiner for Cambridge Veterinary School - Final exam (Pathology)
- 1998      **President of the Association of Veterinary Research Workers and Teachers (AVT&RW)**
- Editor of Journal for Continuing Professional Development**
- External examiner for Cambridge Veterinary School - Final exam (Pathology)
- Initiate programme on molecular BVDV vaccine constructed with chimeric cytokine adjuvancy and ‘marker’ status (funded Novartis Animal Vaccines Ltd)
- Establish commercial support for ‘Elite’ BSc (Hons) programme in molecular, cellular and toxicological pathology with commercial sponsorship (2M)
- 1996      **Head of Department of Pathology & Infectious Diseases** at the Royal Veterinary College, London
- Expert Consultant for International Organisations - EU (visitation to Zimbabwe)
- EU - Chairman of the Expert Panel for the European Commission on BIV infections in cattle
- Establish ‘mission framework’ for RVC pathology with particular focus on clinical pathology services to RVC clinical departments (SAMS and FAEMS)
- Commercial launch of **Bovidec** vaccine developed by Professor Joe Brownlie and his team following 10 years of development work (September)

- 1995**      **Professor of Veterinary Pathology** in the Department of Pathology & Infectious Diseases at the Royal Veterinary College, London
- President - The Veterinary Research Club**
- Lecture tour of USA in Mid-West, New York and New England.
- 1994**      Visiting Professorship in Farm Animal Infectious Disease from The Royal Veterinary College
- Junior President of the "Veterinary Research Club"
- Expert Consultant for International Organisations - EU (visitation to Zimbabwe)
- Extensive investigations into a potential Bovine Immunodeficiency Virus infection of a Cheshire herd ("Bovine AIDS" extensive press coverage)
- Chairman of "biotechnology" workshop for the RCVS 150<sup>th</sup> celebrations - London
- 1993**      Visit to Bali and Australia to investigate the fatal disease of Balinese cattle - Jembrana disease. ODA-funded programme
- AFRC/MRC meeting on lymphoid structure and physiology (to contribute work on dendritic cell pathways in the cannulated lymph node)
- 1992**      ODA-funded collaborative visit to Tübingen and Hannover, Germany
- 1991**      **Expert Consultancy** to OIE Paris to advise on OIE programme and publications
- Successful concluding experiments on the Compton BVDV vaccine for protection of calves to respiratory disease
- Establish in utero BVDV challenge for pregnant heifers and commence vaccine protection trials for pregnant heifers (completion Oct 1992)
- Bovine immunodeficiency virus pathogenesis studies (funded by MRC AIDS programme) with demonstration of persistent viraemia and CD4 T cell involvement
- Pepscan data on BVDV and Hepatitis C virus to show shared epitopes (collaborative with Prof C Howard LSTM&H, London)
- A programme of research was initiated with funding from the Milk Marketing Board (UK)/Meat livestock Commission to examine the germ line transmission of BVDV under experimental conditions and within the normal procedures of embryo transfer (ET). This work provided scientific evidence for the potential for this type of BVDV transmission and guidelines for the cattle industry to safeguard ET procedures
- 1990**      Appointed Rapporteur to the General Assembly of the Office International des Epizooties for 1991 as expert for "Pestiviruses of Ruminants"
- Publication of the Office International des Epizooties "Revue" on Bovine virus diarrhoea virus
- Invited on to Editorial board of Veterinary Immunology & Immunopathology



- 1989 British Council sponsored visit to Eurogentec laboratories in Liege, Belgium to study PCR techniques for BVDV
- Royal Show, Stoneleigh: Co-ordinator of the IAH demonstration of the "Better Cattle Vaccines for 1990's"
- Attend AIDS-directed programme Annual meeting, Sheffield, to present work on Bovine Immunodeficiency Virus (BIV)
- Editor of OIE Review on Ruminant Pestiviruses
- 1988 Appointed as Ruminant Specialist to the Management Board of the Institute of Animal Health
- Co-organised British/French meeting of Veterinary Immunologists in Paris, April
- Consultancy visit on behalf of ODA to India to examine and prepare a collaborative programme on Research on Animal Diseases (ROAD)
- Appointed to the Management Board as the Ruminant Specialist of the IAH
- 1987 Invited speaker to Annual Meeting of Ass. Vet. Surg. Northern Ireland
- Invited to Co-organise the BSI Summer Meeting (2 days) on "Immunology of Persistent Virus Infections" with Dr A A Nash, Dept of Pathology, Cambridge
- 1985-90 Chairman of the Comparative and Veterinary Immunology Society (affiliated to the British Society of Immunology)
- 1985 Co-organised Royal Society of Medicine meeting on "*Immunology of Persistent Infections*" (with Professor Dayan, St Bart's Hospital, London)
- USA/Canada - Lecture tour (7 Universities Florida - Guelph)
- Lectures to Blonde McIndoe Centre for Medical Research, East Grinstead, Sussex, to Cotswold Veterinary Group, to Herefordshire Veterinary Club
- 1984 Initiated the British Comparative and Veterinary Immunology Group which I later affiliated with the British Society of Immunology (BSI)
- 1980 Principal Veterinary Research Officer at Institute of Animal Health, Compton
- 1978 *Basel Institute of Immunology Fellowship* for study on T-cell recirculation at the Basel Institute
- 1977 *Commonwealth Fellowship* awarded to visit Ontario Veterinary College
- 1975 *Post Doctoral Fellowship* awarded by Australian National University
- 1974 **Royal Society (London) - Fellowship** for sabbatical study leave to John Curtin Medical School, Australian National University, Canberra, Australia. Study with Professor Bede Morris on the lymphatic duct cannulation technique and lymphocyte recirculation in sheep

- 1973      Promoted to **Senior Veterinary Research Officer** at Institute of Animal Health, Compton
- 1972      Awarded PhD on thesis entitled "*The isolation and characterisation of antimicrobial proteins from bovine milk*". University of Reading
- 1970      **Veterinary Research Officer** at Institute of Animal Health, Compton
- 1968      **Agricultural Research Council studentship** for PhD studies with Dr K G Hibbitt at the Institute of Research on Animal Diseases, Compton, Newbury
- 1967-68   General veterinary practice in Dorset and Sussex

## Invited Lectures:

### 2009

- a) *"BVD Eradication"* – Wyvern Vet Meeting, Bromyard (Jan)
- b) *"A Foresight Perspective on Future Disease Risks"* – Fore-Can Foresight for Canadian Animal Health Intro Workshop: Applying Foresight to Managing Future Challenges, Ottawa, Canada (Jan)
- c) *"One Medicine Approach to Emerging Diseases"* – Topics in Infection, London (Jan)
- d) *"One World, One Health, but many diseases"* – Laboratory of Government Chemist, Teddington (Feb)

### 2008

- a) *"Foresight – the future disease risk in Africa"* - Foresight, Johannesburg (Jan)
- b) *"BVD Eradication"* – Vet & Farmers Meeting, Cullompton, Devon (Jan)
- c) *"Infectious Diseases – A vision for future detection, identification and monitoring system"* – British Council, Dhaka, Bangladesh (March)
- d) *"Identification, detection and monitoring of infectious disease agents"* – 6<sup>th</sup> Annual Scientific Conference, Chittagong Veterinary & Animal Sciences University, Chittagong, Bangladesh (March)
- e) *"BVD Eradication"* – Farm Health Planning Meeting, Aylesbury (March)
- f) *"BVD Eradication"* – Vet & Farmers Meeting, Axminster, Devon (March)
- g) *"Biosecurity – Who owns disease?"* – The President's Lecture, RASE Seminar Presentation, Butchers Hall, London (April)
- h) *"BVD Eradication"* – Vet & Farmers Meeting, Blandford, Dorset (April)
- i) *"Latest developments in prevention & vaccination of BVD"* Intervet-Schering Plough BVD Workshop in Iran (April)
- j) *"BVD - the disease, the EU dimension and the control"* - BVD Symposium – Poland (May)
- k) *"Latest issues in containing national disease outbreaks"* – DARDNI, Belfast (June)
- l) *"BVD in EU: News, prevalence, Disease and Prevention"* BVD/IBR European Meeting – Madrid (June)
- m) *"The future epidemics of disease"* - Summer RVC Alumnus Association Meeting, RVC (June)
- n) *"BVDV – a delight for pathologists, but a dilemma for clinicians"* – International Meeting of Young Veterinary Pathologists, Turin, Italy (June)
- o) RASE Seminar Presentation at the Royal Show, Stoneleigh (July)
- p) Invited Chair for 2<sup>nd</sup> Bayer Cattle Symposium, Budapest (July)
- q) *"BVD Eradication"* – Intervet meeting, Westpoint Offices, Horsham (July)
- r) 7<sup>th</sup> International ESVV Pestivirus Symposium – Uppsala (Sept)
- s) *"BVD UK – Are we really in control?"* – BCVA Congress, Killarney, Ireland (Nov)
- t) Wildlife Diseases Symposium, Royal Society of Medicine, London (Nov)
- u) *"The Grasshoppers"* Meeting on Biosecurity, Wilton Salisbury (Dec)

### 2007

- a) Royal Society Workshop, Tanzania (January).
- b) *Detection, Identification and Monitoring (The Foresight Project)"* – Animal Health Research, Wellcome Trust, Hinxton (January).
- c) Ghana & Tanzania Follow-Up Workshop – Royal Society (February).
- d) Intervet Early Pregnancy Loss Seminars – Carrickmacross, Co Monaghan & Dundrum, Co Tipperary, Ireland (March).
- e) *"BVD Eradication"* – XL Vets, Easton College, Norfolk (April).
- f) *"Emerging Diseases"* - Foresight Wildlife Workshop (May).
- g) Tel Aviv, Israel (May).

- h) "BVD Vets Workshop" - Easton College, Norfolk (May).
- i) "BVD Eradication" – Penbode Veterinary Group in Bude, Devon (June)
- j) "UK Approach to BVD Control" & "Concept of using inactivated vaccines in BVD Control" – and Chairman of the BVD Symposium – Budapest (June).
- k) Foresight Project, New York/Washington, USA (June).
- l) "Determination of molecular and cellular mechanisms of virulence in field and emerging viruses – SE077" - DEFRA's Statutory & Exotic Diseases Research Review (July).
- m) "FMD – Characterise pathogenesis and persistence of FMDV in pregnant livestock and offspring – SE2933" – DEFRA's Statutory & Exotic Diseases Research Review (July).
- n) BVD Workshop – Royal Veterinary College (July)
- o) Foresight Meeting – Johannesburg, South Africa (Sept)
- p) "BVD Regional Control in Derbyshire" – Knox & Devlin Veterinary Practice, Whaley Bridge, Derbyshire (September)
- q) "Containing national disease outbreaks: latest issues" – BVA Congress, Belfast (September)
- r) "BVD – Eradication possibilities, vaccine strategies" – BCVA Health Initiative Meeting, Tiverton, Devon (Oct)
- s) "BVD – Eradication possibilities, vaccine strategies" – BCVA Health Initiative Meeting, Preston, Lancashire (Oct)
- t) "Bluetongue" – Farm Animal Clinical Club, RVC (Oct)
- u) "The emerging infectious diseases in Africa – risks & control" - Algeria (Nov)
- v) "BVD – Eradication possibilities, vaccine strategies" – BCVA Health Initiative Meeting, Warwick (Nov)
- w) "BVD Eradication" – Farmers Meeting, Rutland (Nov)
- x) "BVD – development in the virus and vaccines" - BCVA Congress – SECC, Glasgow (November).
- y) "BVD – Eradication possibilities, vaccine strategies" – BCVA Health Initiative Meeting, Swindon (Dec)
- z) "BVD Eradication" – Herd Health Seminars, Dublin (Dec)

## 2006

- a) BCVA Conference, Bristol (February).
- b) "Bovine Pestivirus – a suitable case for national eradication?" University of Warwick (March).
- c) North of Ireland Veterinary Association, Stormont, Belfast (March).
- d) "Veterinary Education - The impact of Intercalated Degrees on 1<sup>st</sup> destination & veterinary careers", AVT&RW, Scarborough (April).
- e) "BVD Control", The Bath & West Showground, Somerset (April).
- f) Foresight Launch, Royal Society, London (April).
- g) "Infectious Diseases: Preparing for the future using science to fight the evolving threat of disease in humans, animals & plants", Royal Society, London (May).
- h) Foresight ISTC Conference, Royal Society, London (May).
- i) DEFRA Projects Presentation 'FMDV – the hidden risks of pregnant sheep', London (May).
- j) "Global Diseases & Future Technologies", Royal Veterinary College, London (June).
- k) "What advances will be made in veterinary science?" Postcards from the Future Event, RCVS, London (June).
- l) "Vaccines to protect the unborn foetus – the control of Bovine Pestiviruses" - 4<sup>th</sup> International Veterinary Vaccines & Diagnostics Conference, Oslo (June).
- m) "Foresight Project on Infectious Diseases, Frontiers Meeting on Emerging Zoonotic Infections: Integrating Research, Diagnosis and Surveillance" Wellcome Trust Conference Centre, Hinxton, Cambs (July).
- n) "How we can control BVD in Norfolk & Suffolk" – Farmers Meeting - Easton College, Norfolk (September).
- o) XXIV World Buiatrics Congress, Nice, France (October)

- p) *"The Foresight Programme – Preparing for Future Threats"* – Infectious Diseases: Detection, Identification & Monitoring, BioNet Workshop, Newcastle (October).
- q) *"How we can control BVD in Norfolk & Suffolk"* – Veterinary Meeting - Easton College, Norfolk (November).
- r) *"BVD Control – The 1<sup>st</sup> steps in a thousand have been taken (old Chinese proverb!)"*, BCVA Congress, Southport (November).
- s) *"Can you, and should you, undertake BVDV Control in Spain"* - Intervet – Leon, Oviedo, Santiago de Compostela & Lugo in Spain (November).

## 2005

- a) Herts & Beds Veterinary Society, Stevenage (February)
- b) BVDV Summer Symposium, Wellington, New Zealand (March)
- c) SGM, Edinburgh (April)
- d) EU BVDV Control Group Meeting, London (April)
- e) EU FMD Meeting, Rome (May)
- f) EFSA EU FMD Working Group, Pirbright (June)
- g) EU BVDV Control Group Meeting, Thessaloniki, Greece (June)
- h) EFSA EU FMD Working Group, Brussels (July)
- i) Guide Dogs Gala Day, Moreton Morrell, Warwickshire (July)
- j) Foresight Meeting, Entebbe, Uganda (July-August)
- k) EFSA EU FMD Working Group, Brussels (September)
- l) ESVV 6<sup>th</sup> Pestivirus Symposium, Thun, Switzerland (September)
- m) BCVA Conference, Cornwall (October)

## 2004

- a) *"Control of BVDV in veterinary practice"*, Co May, Ireland (January).
- b) *"Pathogenesis of BVDV"* - West Wales Veterinary Clinical Club, Carmarthen (February).
- c) BVDV Group Meeting, EU Thematic Network, Grindelwald, Switzerland (February).
- d) BVDV Vaccine Meeting, EU Thematic Network, Rome (May).
- e) Seminars on *"Pathogenesis and Control of BVDV in Cattle & Sheep"* - Sheep & Beef Cattle Vet Seminar, Auckland, New Zealand (May).
- f) 7<sup>th</sup> International Veterinary Immunology Symposium (IVIS), Quebec City, Canada (July).
- g) *"BVDV Control & Vaccination Strategies"* - Cattle Association of Veterinary Ireland Conference 2004, Bunratty, Co Clare (October).
- h) *"Strategies for BVDV Control"* - 2<sup>nd</sup> European Symposium on BVDV Control, Porto, Portugal (October).

## 2003

- a) Wellcome Trust Conference - *"Animal Health in the Developing World Initiative"*, Berkshire (March).
- b) AVT&RW Conference, Royal Hotel, Scarborough (April).
- c) *"Pathogens of Pestiviruses & Orbiviruses"* 3 invited lectures, Sicily (May).
- d) *"Future animal vaccines"* & Chair of International Veterinary Vaccines Conference, London (June).
- e) *"Pestivirus vaccines – the way forward"* at the International Human & Viral Vaccination Conference, *"Viral Vaccines 2003"*, Edinburgh (July).
- f) *"Economics of BVDV & BVDV Control – current knowledge"* BVD Control Network Meeting, Edinburgh (September).
- g) *"BVD vaccines – success, risks and failures"*, The Dutch Cattle Veterinary Association [6 lectures across the Netherlands] (September).

- h) *"Perspectives on FMD & BSE Implications on Trade"* - International Forum on Accidental Release or Deliberate Use of Biological Agents Affecting Food & Agriculture, Texas, USA (October).
- i) *"BVDV strategies for control – the European perspective"* BCVA Conference, Amsterdam (October).

## 2002

- a) Joint Meeting of the SGM, ESCV and ESVV on Viral Zoonoses, Royal College of Physicians, London, (January).
- b) Introduction to Forensic Pathology, Royal Veterinary College, Hawkshead Campus, (February).
- c) RVC/AHT Joint Scientific Meeting at the Animal Health Trust, (March).
- d) Eastern Counties Vet Society, (March).
- e) LVA Meeting, Kendal, (March).
- f) AVT&RW Conference, Royal Hotel, Scarborough, (March).
- g) 11<sup>th</sup> Veterinary Biologics Public Meeting, Ames, Iowa, (April).
- h) BVDV Detection and Control, Ames, Iowa, (April).
- i) IOB Foot & Mouth Symposium, Exeter University, (April).
- j) Shropshire Veterinary Association, AGM, (May).
- k) DEFRA Workshop on the Modelling of FMD and other Exotic Diseases of Livestock, Westminster, London (May).
- l) Pathogenesis of Pestivirus Diseases, The Faculty of Veterinary Medicine, Turin, (May).
- m) Virus Weekend, Oxford, (June).
- n) International Union of Microbiological Societies, The World of Microbes, Paris, (July/August).
- o) XXII World Bui atrics Congress, Hanover, Germany, (August).
- p) International Pestivirus Conference, Cambridge, (August).
- q) European Society of Veterinary Pathology, Turin, (September).
- r) *"Oral lesions in cattle"*, Glasgow University, (October).
- s) BVD Control Network Meeting, Copenhagen, (December).

## 2001

- (a) Cornwall Veterinary Association VLA, Truro (February).
- (b) *"Molecular Approaches to Vaccination"*, The Royal Society of Medicine, London (February).
- (c) *"Pestivirus Contamination Identification, Practical Consequences & Regulatory Issues for Biologicals, International Symposium"*, EDQM Conference, Paris, France (March).
- (d) *"A Virus in Sheep's Clothing"*, Opening Address at BSAVA Congress (April).
- (e) BVA, North Wales, (May).
- (f) *"Strategic decisions for FMD vaccination in the UK"*, Federation of Veterinarians of Europe General Assembly Meeting, Budapest, (May).
- (g) *"Pestivirus Pathology on Swine Species"* Faculty of Veterinary Medicine of Turin, Turin, Italy (June).
- (h) University of Guelph, Toronto, Canada, (August).
- (i) University of Saskatoon, Canada, (August).
- (j) *"Beef 2001"*, National Beef Association, Royal Agricultural College, Cirencester (September).
- (k) BCVA Joint Conference on *"Bovine Infectious Diseases"*, Belfast Conference Centre, Ireland, (October).
- (l) *"Foot & Mouth Disease UK 2001 – A Virus in Sheep's Clothing"* - AAVLD Annual Meeting, Pennsylvania, (November).
- (m) BVZS Autumn 2001 Meeting, *"Zoo and Exotic Diagnostics"*, (November).
- (n) *"BVD – A virus using terrorist tactics"* – Edinburgh University, (November).

## 2000

- (a) 5<sup>th</sup> Asia Pacific Congress of Medical Virology, Bali, Indonesia (June)
- (b) 2<sup>nd</sup> International Veterinary Vaccines and Diagnostic Conference, Oxford (July).
- (c) *"Veterinary Virology in the New Millennium"*, 5<sup>th</sup> International Congress of Veterinary Virology, Brescia, Italy (August).
- (d) 8<sup>th</sup> Meeting of the European Society of Veterinary Pathology, Amsterdam, The Netherlands (September).
- (e) *"Applications & Techniques in Veterinary Pathology"*, The Royal College of Pathologists One Day Symposium, London (October).

## 1999

- (a) BCVA Regional Meetings, Forte Hotel Washington & Southgate Hilton, Exeter (January)
- (b) *"Prevention of Viral Diseases by Vaccination – Vaccination Versus Non-Vaccination"*, Second Intervet Symposium, Utrecht, The Netherlands (February).
- (c) European Society for Veterinary Pathology, 4<sup>th</sup> Pestivirus Meeting, Gießen, Germany (March).
- (d) *"Current Topics in Veterinary Science, 1999"*, Association of Veterinary Teachers & Research Workers", 53<sup>rd</sup> Scientific Meeting, Scarborough (March).
- (e) *"Medical and Veterinary Healthcare: a seamless collaboration"*, Royal College of Veterinary Surgeons, London (June).
- (f) BVD Expert Team Evaluation of Field Cases, The Netherlands (July).
- (g) *"Enhancing the Efficacy of Cattle Vaccines"*, Danish Veterinary Association, Denmark (September).
- (h) 17<sup>th</sup> Meeting of the European Society of Veterinary Pathology, Nantes (September).
- (i) *"Seminar for the Bovine Practitioner"*, Piacenze, Italy (October).

## 1998

- (a) *'The problems for cattle health caused by BVDV'* - Liverpool Veterinary School (January)
- (b) *'Pathology for the Bovine Practitioner'* - RVC symposium for BCVA members (February).
- (c & d) *'BVDV control and vaccination strategies'* - BCVA sponsored lectures on BVDV Road show in both York and Chester (February).
- (e) *'Pathological consequences for reproduction after BVDV infections'* Society for the Study of Animal Breeding, Malvern Worcester (March).
- (f) *'Plagues, Pestilences and Veterinary Students'* Association of Veterinary Students Annual Conference, RVC, London (March).
- (g) *'BVDV - a virus that avoids, evades and subverts the immune response'* - Veterinary Immunology Group symposium at AVTRW Annual Congress, Scarborough, Yorks (April).
- (h) *"Bovine Viral Diarrhoea (BVD) Virus – A significant cause of Infertility and Reproduction Loss in Cattle"*, Farmers Club, London (May).
- (i) *"Framework Five, Specific Programme in Quality of Life and Management of Living Resources, OST Workshop"*, DTI Conference Centre, London (June).
- (j) Association of Veterinary Teachers & Research Workers Council Meeting, Birmingham (June)
- (h) *'Enhancing the Efficacy of Cattle Vaccines'* - XXth World Buiatrics Congress, Sydney, Australia (July).
- (i) *"Enhancing the Efficacy of Cattle Vaccines"*, BCVA Autumn Meeting, Chester (October)

## 1997

- (a) *'Pathology - the central science of veterinary medicine'* - Cornwall Veterinary Association (February).
- (b) *'BVDV vaccination procedures and benefits'* - Yorkshire Veterinary Association (February).

- (c) *'Viral causes of foetal insufficiency'* - Wellcome Trust sponsored 2-day meeting on 'Foetal insufficiency and long term sequelae.' Aberdeen, Scotland (March).
- (d) *'Bovine pestiviruses: Clinical Conundrum with Molecular Clues'* JTL (Larry) Smith Memorial Lectures at the Western College of Veterinary Medicine, Saskatoon, Canada (March).
- (e) *'Viral causes of bovine infertility'* on RCVS Diploma course for Cattle Health and Reproduction, Liverpool (April).
- (f) *'BVDV pathogenesis and vaccine control programmes'* - 3 lectures in Israel (Galilee, Askalon & Jerusalem).
- (g) *'Pestivirus disease - pathogenesis and diagnosis'* - 2 lectures in Cyprus (May).
- (h) *'Continuing Professional Development in Toxicological Pathology, Module 5 – Digestive System'*, University of Cambridge Veterinary School (July).
- (i) *'Plagues - the European dimension'* Guest Dinner speaker at the European Society of Veterinary Virology symposium on *Virus survival and Vaccination*. Edinburgh (August).
- (j) *'Historical and present day understanding of BVDV infections'* 1st European Congress on *Pestivirus Diagnosis, Control and Eradication* Lillehammer Norway (September).
- (k) *'BVD - how important is it?'* - British Veterinary Association Annual Congress Edinburgh, Scotland.
- (l) *'Maternal recognition of foetal infection with bovine virus diarrhoea virus (BVDV) - the bovine pestivirus'* 1st International Flaviviridae Symposium, Lyon, France (October).
- (m) *'BVD/Mucosal disease - new developments'* Irish Veterinary Congress, Galway, Ireland (October).
- (n) *'The role of vaccination in BVD control'* Scottish Agricultural Colleges biennial Conference, Pitlochry, Scotland (November).

#### 1996

- (a) *'BVDV - a dilemma for diagnosis and control'* - Wiltshire Veterinary Society, Swindon (January).
- (b) *'Pestivirus infections of farm animals'* - Edinburgh Veterinary School (February).
- (c) *'Bovine viruses causing disease in cattle'* - Galway Veterinary Group, Ireland (February).
- (d) *'Bovine immunodeficiency virus infections in British cattle'* - EC Commission, Brussels (February).
- (e) *'Jembrana disease virus - a new lentivirus infection of cattle'* - CSIRO Congress, Bali, Indonesia (June).
- (f) *'Foetal infections with pestiviruses'* - 50th year Symposium of BVDV Discovery in 1946 Cornell University, USA.
- (g) *'BVDV - is control possible?'* - World Association of Veterinary Microbiologists and Immunologists, Edinburgh (July).
- (h) *'Bovidec; a novel vaccine against BVDV'* - commercial launch of Bovidec vaccine developed by Professor Joe Brownlie and his team following 10 years of development work (September).
- (i) *'Viral recombination in BVDV genomes in persistent infection'* and Chairman - 3rd ESVV Symposium of Pestivirus Infections, Lelystad, Netherlands.
- (j) *'BVDV diagnosis and control - new perspectives'* Sussex Veterinary Society, West Grinstead, Sussex (October).
- (k) *'The hazards of viral infection on foetal survival and wellbeing'* Reproduction and Development Group, RVC (November).

#### 1995

- (a) *"Mechanisms of Foetal tolerance to Pestiviruses"*. Medical School Zurich Switzerland (Professor Rolf Zinkernagel).
- (b) *"Pathogenesis of Pestivirus Infections"*. Veterinary School Bern, Switzerland (Professor Ernst Peterhans).
- (c) *"Pathways of BVDV persistent infections"*. Veterinary Research Club, London.



- (d) *"Infections with haemorrhagic BVDV isolates"*. Microbiology and Pathology Dept, Bristol University.
- (e) *"Pestiviruses of Man and Animals"* - Society of General Microbiology - Celebration of 50<sup>th</sup> Golden Jubilee.
- (f) 8 lecture tour of USA from Oklahoma City, Kansas, Nebraska to New York, Plum Island Research Centre and Cornell University.
- (g + h) Invited lectures at the Edinburgh & Cambridge Veterinary Schools
- (i + j) Invited lectures to the Veterinary Investigation Centres at Wye, Kent and at Winchester, Hampshire (to celebrate the opening of their new building).

#### 1994

- (a) *"Pathogenesis of Pestiviruses"* and Chairman of session on Pathogenesis at International Symposium on "Hepatitis C and related viruses" in San Diego, California (July/Aug).
- (b) *"Vaccine control and pathogenesis"*. British Cattle Veterinary Association (April).
- (c) *"Molecular epidemiology of Pestiviruses"*. Natural Environmental Research Council, Oxford.
- (d) *"Pestivirus infections of wildlife species"*. Nuffield Institute of Zoology, London.
- (e) *"Acute infections with pestiviruses"*. SmithKline Beecham lectures at the National Buiatrics Congress in Paris & Munich.

#### 1993

- (a) *"The potential for biotechnology in cattle practice"*. British Cattle Veterinary Association meeting, London (January).
- (b) *"In today's philosophy, is Koch's Postulate still central to the definition of disease-causing agents - Mucosal Disease of cattle"* Karger Symposium on "Virus and virus-like disease causing Agents". Basel, Switzerland (March).
- (c) *"Update on BVDV infections, pathogenesis and control"* Veterinary Investigation Centre, Langford, Bristol (March).
- (d) *"Pathogenesis of bovine virus diarrhoea virus"*. Glasgow Veterinary School. Professor David Onions (March).
- (e) *"Aspects of BVDV pathogenesis and control"*. Invited lecture tour of 4 Scottish VI centre (June).
- (f) *"Potentiating immune responses to viral antigen"*. SKB lecture - Munich Germany (July).
- (g) C-Vet Lecture tour - 3 centres in Denmark (July).
- (h) *"BVDV and Hepatitis C correlations"*. Wellcome lecture - Beckenham (November).
- (i) *"BVDV control and eradication"*. Lecture tour of Scottish Islands - Shetlands and Orkneys (November).
- (j) *"Jembrana disease and its association with bovine immunodeficiency-like virus (BIV)"*. ODA sponsored visit to Australia and Indonesia - (December).

#### 1992

- (a) *"Recent developments in pestivirus research"* in Tübingen & Hannover, Germany (March).
- (b) *"Pathogenesis, epidemiology and control of BVDV"*. Danish Veterinary Association at Kolding & Aalborg (May).
- (c) *"The persistent viral infection avoids immune recognition? - bovine virus diarrhoea virus"*. International Veterinary Immunology Symposium, Budapest, Hungary (August).
- (d) *"Mucosal disease: A practitioner's dilemma or a researcher's delight"*. Pfizer Lecture at the World Buiatrics Congress, St Pauls/Minneapolis, Minnesota, USA (August).
- (e) *"The role of pestivirus persistence in mucosal disease and reproductive failure"*. 2<sup>nd</sup> ESVV International Symposium on Ruminant Pestiviruses, Annecy, France (October).

- (f) *"Bovine virus diarrhoea virus and the immune system"*. British Veterinary Association Congress, Harrogate 1992 (October).
- (g) *"Clinical and experimental aspects of BIV in cattle"* at meeting on Immunodeficiency caused by HIV and other lentiviruses in human beings and animals at the Royal Society of Medicine (November).

#### 1991

- (a) *"Transmission of persistent virus infections"*. Trinity College, Veterinary School, Dublin, Eire (January).
- (b) *"Pestiviruses - another group of Togaviruses which cause congenital infections in animals"*. 50<sup>th</sup> Anniversary of Sir Norman Gregg's discovery that Rubella causes congenital defects and Silver Jubilee of virology at St Thomas' Hospital (February).
- (c) *"MHC expression at the bovine maternal fetal interface"*. (Co-author with S Ellis) Materno-fetal Immunobiology Group/Veterinary Immunology Group London (October).

#### 1990

- (a) *"BVDV pathogenesis - a European dimension"*. Quebec, Canada.
- (b) *"Symposium on pestiviruses"*. Lincoln, Nebraska.  
Also, lectures given at Clay Centre, Nebraska, USA, and at NADC, Ames, Ohio, Nebraska, USA.
- (c) *"The pathogenesis of bovine virus diarrhoea virus infections"*. Symposium on Ruminant Pestivirus Infections. ESVV, Hannover, Germany.
- (d) *"Tolerance to viral infections"*. BVA Congress (London).
- (e) *"International perspective on the epidemiology and pathogenesis of ruminant pestivirus infections"*. OIE General Assembly, Paris.

#### 1989

- (a) *"Pathogenesis of Mucosal Disease and Molecular Aspects of Bovine Virus Diarrhoea Virus"*. 1<sup>st</sup> Congress of European Society of Veterinary Virology, Liege, Belgium.
- (b) *"The failure of the cytopathogenic biotype of BVDV to induce immunotolerance"*. 2<sup>nd</sup> International Congress of Veterinary Immunology, Hannover, Germany.
- (c) *"BVDV persistence - a crisis for the immune system"*. 11<sup>th</sup> Congress of World Association of Veterinary Microbiologists and Immunologists (WAVMI), Perugia, Italy.
- (d) *"Clinical aspects of the BVD/MD Complex"*. Irish Veterinary Congress, Cork, Ireland.
- (e) *"Vesicular and vesicular-like diseases of the young calf"*. 1<sup>st</sup> International Symposium on "Important disease of the young calf" - Turkey.
- (f) *"Abortion and stillbirths in cattle"*. Scottish VIS Congress, Scotland.
- (g) *"The immune mechanisms to pestivirus infection of cattle"*. Veterinary Research Club, London.

#### 1988

- (a) *"Mucosal disease-sequential studies on the infectivity of BVDV in the gut-associated lymphoid tissue"*. 15<sup>th</sup> World Buiatrics Congress, Palma, Spain.
- (b) *"The immunology of persistent viral infections"*. British Veterinary Association Congress, Lancaster.
- (c) *"Abortion in cattle - the mechanisms and causes"*. British Veterinary Cattle Association, York.

#### 1987

- (a) *"Mucosal disease - a partition for non-cytopathic and cytopathic virus in pathogenesis"*, 23<sup>rd</sup> World Veterinary Congress, Montreal, Canada.

## ***Supervised PhD Programmes***

### **Completed PhD's:**

**1996**

**Paul Richard Heaton** – PhD – *“The Immunological and Molecular Characterisation of Bovine Immunodeficiency-Like Virus (BIV) in Cattle”* – March 1996

**1998**

**Fengsheng Lin** – PhD – *“Duration of Infection with Swine Vesicular Disease Virus in Pigs”* – March 1998  
(Co-supervised with Dr David McKay)

**1999**

**Subash C Das** – PhD – *“Studies on Chimeric Rinderpest-Peste Des Petits Ruminants (RP-PPR) Viruses Produced Using Reverse Genetics”* – October 1999 (Co-supervised with Prof Tom Barrett)

**2000**

**Moira Desport** – PhD – *“Genomic variation and cell tropism of Bovine Viral Diarrhoea Virus”* – February 2000 (Co-supervised with Dr Margaret Collins)

**Isabelle Nobiron** – PhD – *“DNA Vaccination Against Bovine Viral Diarrhoea Virus in Mice and Cattle”* – September 2000 (Co-supervised with Dr Margaret Collins)

**2001**

**Susan A Stephens** – PhD – *“Phenotypic and Functional Characterisation of Dendritic Cells in Bovine Afferent Lymph (Afferent Lymph Veiled Cells)”* – January 2001 (Co-supervised with Prof Chris Howard)

**2003**

**Pradyot Dash** – MPhil - *“Development of Reverse Genetics for Peste des Petits Ruminants Virus”* – June 2003 (Co-supervised with Prof Tom Barrett)

**Madhuchhanda Mahapatra** – PhD – *“Application of reverse genetics to study the role of matrix (M) protein in morbillivirus replication: chimeric viruses as potential marker vaccines”* – 2003 (Co-supervised with Prof Tom Barrett)

**Maria Stokstad** – PhD – *“Pestivirus in cattle, with emphasis on mucosal disease”* - 2003 (Co-supervised with Prof Torleiv Loken)

**2004**

**Sushilla Maan** – PhD – *“Complete nucleotide sequence analyses of genome segment 2 from twenty-four serotypes of bluetongue virus: Development of nucleic acid based typing methods and molecular epidemiology”* – 2004 (Co-supervised with Prof Peter Mertens).

**Caren Paterson** – PhD – *“The Development of a Small Animal Model for Hepatitis C Virus (HCV) using Chimeric HCV-BVDV (Bovine Viral Diarrhoea Virus) Replicons”* - 2004 (Co-supervised with Dr Margaret Collins)

2006

Natalie Young – PhD – “Bovine Viral Diarrhoea Virus subunit vaccines: contribution of non-structural proteins” - 2006 (Co-supervised with Dr Margaret Collins)

Pradyot Dash – PhD – “Study of Foot-and-Mouth Disease Virus infection and subsequent innate immune responses using a porcine respiratory epithelial model” - 2006 (Co-supervised with Dr Haru Takamatsu & Dr Paul Barnett)

2007

Karin Darpel – PhD – “The bluetongue virus ‘ruminant host – insect vector’ transmission cycle, the role of *Culicoides* saliva proteins in infection” (Co-supervised with Prof Peter Mertens, Dr Philip Mellor & Dr Haru Takamatsu)

Veronica Fowler – PhD – “The VP1 G-H loop of FMDV: Importance for protection and exploitation in marker vaccines” (Co-supervised with Dr David Paton & Dr Paul Barnett)

Sambit Nanda – PhD – “Evasion of host innate immune response by Rinderpest virus” (Co-supervised with Dr Michael Baron)

Simon Priestnall – PhD – “The role of a novel coronavirus in canine infectious respiratory disease” (Co-supervised with Dr Kerstin Erles)

Eoin Ryan - PhD - “The pathogenesis of foot-and-mouth disease in foetal and neonatal lambs” (Co-supervised with Dr Zhidong Zhang)

2008

Virginie Doceul – PhD – “Cellular response to classical swine fever virus” (Co-supervised with Dr Julian Seago & Dr Bryan Charleston)

#### Current PhD's

Manjunatha Belaganahalli – PhD – “Full genome sequencing and phylogenetic analyses of different *Orbivirus* species” (Co-supervised with Prof Peter Mertens)

Jitendra Biswal – PhD – “Evaluation of mucosal immunity in FMDV vaccinated and infected domestic ruminants” (Co-supervised with Satya Parida)

Richard Booth – PhD – “Bovine Virus Diarrhoea (BVD) virus – a longitudinal farm study on biosecurity, health profile and cost benefit for control” (Co-supervised with Prof Dirk Pfeiffer)

Hubert Buczkowski – PhD – “Development of a negatively marked vaccine for Rinderpest & PPR viruses along with companion diagnostic tests” (Co-supervised with Prof Tom Barrett & A Banyard)

Senthil Chinnakannan – PhD – “Role of non-structural proteins of rinderpest virus in blockade of interferon action” (Co-supervised with Michael Baron)

Antonia Ganser – PhD – “Bovine Virus Diarrhoea (BVD) virus – a longitudinal farm study on biosecurity, health profile and cost benefit for control” (Co-supervised with Dr George Gunn)

Aravindh Babu Ramasamy Parthiban – PhD – “Development of vector based FMD vaccine for increasing local immune response against FMDV” (Co-supervised with Satya Parida)

Rob Pope - PhD - “An investigation of the pathogenesis of Peste-des-petits Ruminants Virus with special emphasis on the early stages of infection” (Co-supervised with Prof Tom Barrett)

Stephanie Reed – PhD – “Molecular and cellular mechanisms of virulence in BVDV” (Co-supervised with Dr Carole Thomas & Dr Margaret Collins)

Amanda Stalker – PhD – “Functional and phenotypic characterisation of bovine plasmacytoid dendritic cells” (Co-supervised with Dr Dirk Werling)

Ryan Waters – PhD – “Transmission and persistence of foot and mouth virus in the ovine foetus” (Co-supervised by Dr Zhidong Zhang)

**Eva Veronesi** – PhD – *“Variation in transmission competence of Culicoides populations, and the genetic basis for differences in transmissibility of BTV strains”* (Co-supervised with Prof Peter Mertens, Prof Philip Mellor & Dr Simon Carpenter)

## Grants Awarded

(since entering the Royal Veterinary College September 1995)

Year Awarded	Grant Body	Title	Amount
1996	Wolfson Foundation	Molecular Pathology of equipment fund	112,500
	BBSRC	Define biological & molecular properties of cattle dendritic cells	252,324
	Grampian Pharm	Vaccine development	154,400
	ODA	Development of ELISA and JDV	148,567
	MFM labs	Evaluation of BVDV vaccine potency	25,500
1997	Grampian Pharm	Grampian Fellowship	101,700
	Grampian Pharm	Colostrum/serological protection studies	36,500
	HRH	Equine pathology residency	66,000
1998	Wellcome Trust	Molecular analysis of FIV/malignancy	298,955
	RCVS	John Lord Perry research scholarship	49,141
	Cebiphar	Vaccine study BVD/RSV	64,262
	Cebiphar	BVDV in utero protection study	117,000
1999	Glaxo Wellcome	Chimeric HCV/BVD study	75,000
	Vericore Ltd	Snr Fellowship in vaccine development	164,943
	Vericore Ltd	Fellowship in vaccine development	152,912
	ODA/DFID	Development of simple virus assays for Jembrana Disease Virus	152,049
	SmithKlineBeecham	Pathology residency program CUVS/RVC	450,000
2000	Glaxo Wellcome	European Centre for Toxicologic Pathology	500,000
	SmithKlineBeecham	European Centre for Toxicologic Pathology	500,000
	AstraZeneca	European Centre for Toxicologic Pathology	500,000
	Pfizer Foundation	European Centre for Toxicologic Pathology	500,000
	Dogs Home Battersea	An investigation of the aetiology and epidemiology of Canine Infectious Tracheobronchitis (kennel cough complex) in rescue dogs	300,000
	Guide Dogs for Blind	An investigation of the aetiology and Epidemiology of Canine Respiratory Disease in Dogs within GDBA kennels	126,725
2002	Dogs Home Battersea	An investigation into the endemic diseases in the Home	300,000

	Novartis	Development of BVDV Marker Vaccines - Fellowship	307,029
	Novartis	Development of BVDV Marker Vaccines - Senior Fellowship	227,958
2004	DEFRA	An integrated approach to biosecurity on UK cattle and sheep farms; evaluating existing measures for endemic diseases against exotic threats	152,340
	DEFRA	FMD – Characterise pathogenesis and persistence of FMDV in pregnant livestock and offspring	615,045
	DEFRA	BVDV – Determination of molecular and cellular mechanisms of virulence in field and emerging viruses	1,306,949
	Wellcome Trust	Sponsorship of BSc (Hons) Vet Path (5 years)	500,000
2005	Pfizer	Development of a new canine respiratory vaccine	474,797
	Pfizer	BVDV vaccine in a field trial	200,815
2007	EBLEX	BVD control programme in Norfolk & Suffolk	24,000
	DEFRA	Biosecurity Chip	160,842
	Novartis	BVD Marker Vaccine Programme	309,016
2008	Wellcome Trust	Sponsorship of BSc (Hons) Vet Path	40,000
	Pfizer	Development of novel vaccine against CIRD	600,000
	DEFRA	FMD – Characterise pathogenesis and persistence Of FMDV in pregnant livestock and offspring	48,971
	DEFRA	BVDV – Determination of molecular and cellular mechanisms of virulence in field and emerging viruses	50,000
	Wellcome Trust	SACIDS	53,000

#### Patents held (by Professor Joe Brownlie)

1. **BVDV inactivated vaccine (with C J Howard and M C Clarke)** – licensed to Novartis Animal Vaccines Ltd
2. **Canine Respiratory Coronavirus (with K Erles)** – Multiple national and regional phase patent applications derived from PCT Patent Application No. PCT/GB2003/002832 in the name of The Royal Veterinary College have been applied for, some of which have now granted.
3. **Mixed vaccine/Kennel cough with inclusion of Canine Respiratory Coronavirus (with K Erles and V Chalker)** – Multiple national and regional phase patent applications derived from PCT Patent Application No. PCT/GB2004/002865 in the name of The Royal Veterinary College have been applied for, some of which have now granted.

4. **Marker BVDV Vaccine (with Margaret Collins, Carole Thomas & Ian Thompson)** – Patent applied for.

### ***Refereed Publications: 1971-2009***

1. **Brownlie, J.** (1971). Antimicrobial proteins in bovine neutrophils. *Biochemical Journal* 125:81-82
2. Hibbitt, K G, **Brownlie, J** & Cole, C B. (1971). The antimicrobial activity of cationic proteins isolated from the cells in bulk milk samples. *Journal of Hygiene (Cambridge)* 69:61-68
3. **Brownlie, J.** (1972). The isolation and characterisation of antimicrobial proteins from bovine milk. *Ph.D. Thesis, University of Reading* (see Dissertation Abstract – No 8)
4. **Brownlie, J** & Hibbitt, K G. (1972). Antimicrobial proteins isolated from bovine cervical mucus. *Journal of Reproduction and Fertility* 29:337-347
5. Gourlay, R N, Howard, C J & **Brownlie, J.** (1972). The production of mastitis in cows by the intramammary inoculation of T-mycoplasmas. *Journal of Hygiene (Cambridge)* 70:511-521
6. Gourlay, R N, **Brownlie, J** & Howard, C J. (1973). Isolation of T-mycoplasmas from goats, and the production of subclinical mastitis in goats by the intramammary inoculation of human T-mycoplasmas. *Journal of General Microbiology* 76:251-254
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10. Howard, C J, Gourlay, R N & **Brownlie, J.** (1974). Immunity in experimental T-mycoplasma mastitis. *Infection and Immunity* 9: 400-403
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12. Howard, C J, **Brownlie, J**, Gourlay, R N & Collins, Jacqueline. (1975). Presence of a dialysable fraction in normal bovine whey capable of killing several species of bovine mycoplasmas. *Journal of Hygiene (Cambridge)* 74: 261-270
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14. **Brownlie, J.** (1979). The effect of an intramammary infusion of endotoxin on the establishment of experimental mastitis by *Streptococcus agalactiae* in the cow. *Journal of Hygiene (Cambridge)* 83:103-109



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16. **Brownlie, J**, Howard, C J & Gourlay, R N. (1979). The effect of an intramammary infusion of endotoxin on experimentally induced mycoplasmal mastitis. *Journal of Hygiene (Cambridge)* 83:501-505
17. Gourlay, R N, Howard, C J & **Brownlie, J**. (1979). Inoculation of *Acholeplasma laidlawii* strains and *Acholeplasma axanthum* into the bovine mammary gland. *Veterinary Record* 105:100-102
18. Howard, C J & **Brownlie, J**. (1979). Interaction of certain bovine immunoglobins with complement in a single radial haemolysis system. *Research in Veterinary Science* 27:388-389
19. Austin, A R, Whitehead, D C, Le Du, Y L P & **Brownlie, J**. (1980). The influence of dietary iodine in the blood serum of cows and calves in the perinatal period. *Research in Veterinary Science* 28:128-130
20. **Brownlie, J**, Nuttall, P A, Stott, E J, Taylor, G & Thomas, L H. (1980). Experimental infection of calves with two strains of bovine virus diarrhoea virus: certain immunological reactions. *Veterinary Immunology and Immunopathology* 1: 371-378
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